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Hyphomycetes: *Linodochium sinense* sp. nov. and new records from fallen *Sycopsis sinensis* leaves in China

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Abstract — Among hyphomycetes collected from dead leaves of *Sycopsis sinensis* in Houhe National Nature Reserve, Wufeng, Hubei, China, a sporodochial fungus new to science, *Linodochium sinense*, is described and illustrated. It develops yellow conidiomata and 2-celled conidia that are filiform, colorless, smooth, 34–40 × 1.1–1.5 µm. *Candelabrum microsporum*, *Chalara affinis*, *Cylindrocladium madagascariense,* and *Subulispora britannica* are new records from China, while *Menisporopsis novae-zelandiae* is newly reported from mainland China.

Key words — anamorphic fungi, saprobe

Introduction

Houhe National Nature Reserve in Wufeng Tujia Autonomous County, Hubei, China is exceptional for its rich biodiversity and rare species. With over 2292 species of vascular plants including 29 endangered species (Song & Liu 1999, Li et al. 2005), the Reserve also possesses some species native only to China (Dang et al. 2004, Li et al. 2005). Its fungal diversity is almost entirely unexplored, and only two studies (on ascomycetes and polypores) have been conducted there (Li et al. 2007, Zhuang et al. 2007).

Sycopsis sinensis Oliv. (*Hamamelidaceae*) is a native evergreen broadleaf woody plant that grows sporadically in mixed evergreen broadleaf forests or bushes at elevations of 1000–2000 m in southern China (Li et al. 2003). The largest population of *S. sinensis* as dominant species has been reported in Houhe National Nature Reserve (Liu et al. 1999).

Two field trips were made to the Reserve to collect hyphomycetes in August 2008 and May 2009. Hyphomycetes on dead leaves of *S. sinensis* were studied

and categorized. Three new hyphomycetes from the two surveys have already been published, one of them from *S. sinensis* (Li et al. 2010, Li et al. 2011). Five additional hyphomycetes from *S. sinensis* are reported here, one as a new species, three as new records from China, and one as a new record from mainland China.

Materials & methods

Sporodochia, conidiophores and conidia of the fungus were mounted in lacto-fuchsin (0.1 g acid fuchsin, 100 ml 85% lactic acid; Carmichael 1955) or 85% lactic acid. Microscopic observations were made using bright field and Nomarski differential interference contrast optics. Photomicrographs were taken with an Olympus MicroFire digital camera (Goleta, CA). Fungal structures were measured with PictureFrame 2.3 software (Goleta, CA). Measurements of the fungal structures were statistically analyzed with Microsoft Office Excel 2010 with 95% confidence interval of means. The results are presented as ranges and mean ± standard deviation. Q = length/width ratio and n = the number of fungal structures measured. Herbarium acronyms follow Index Herbariorum (Thiers 2013).

Taxonomy

Linodochium sinense D.W. Li, Jing Y. Chen & Yi X. Wang, **sp. nov.** Figs 1–6

MycoBank MB 804385

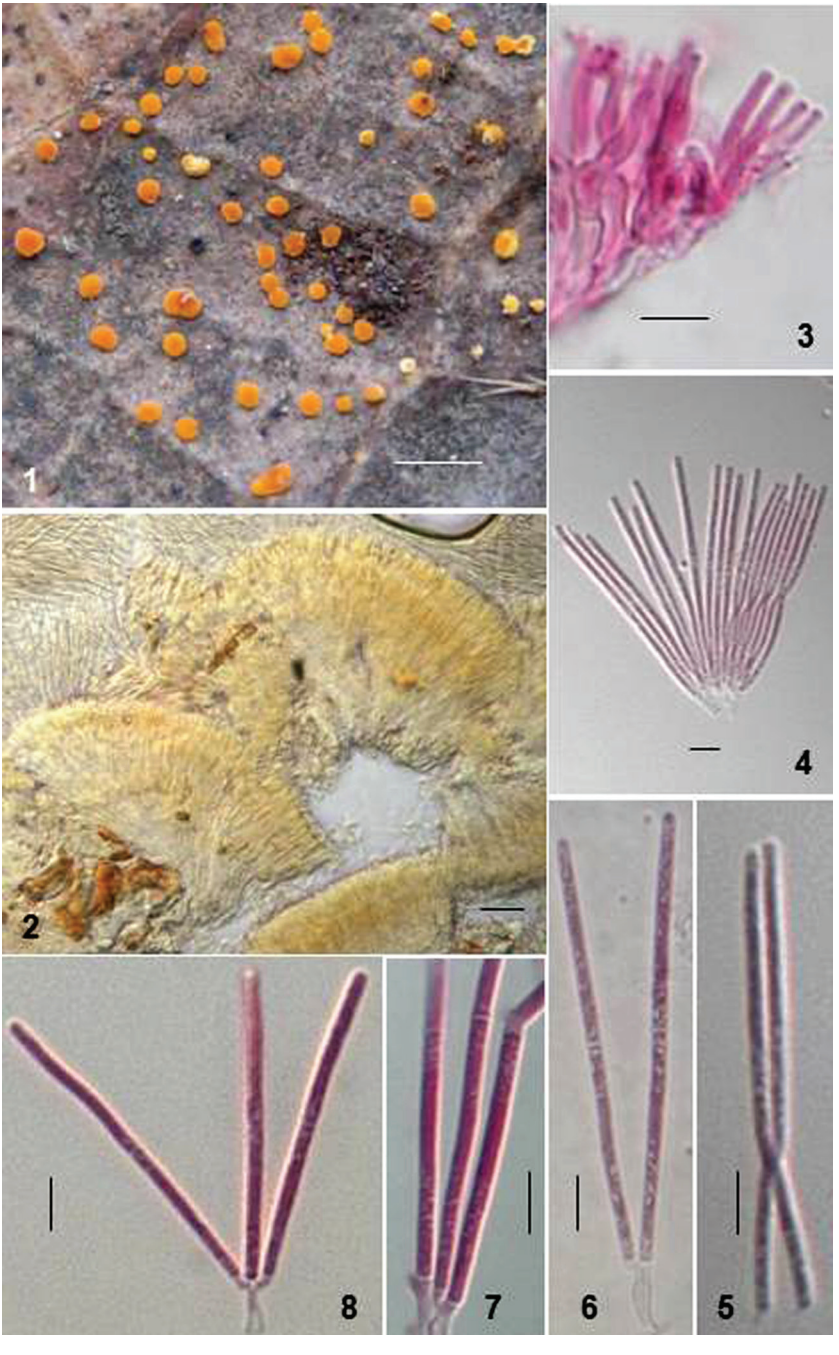
Differs from other *Linodochium* spp. by conidiogenous cells that bear 1–3 (mostly 2) 1-septate conidia with dichotomous denticulate apices and conidial anastomoses that form x-shaped derivative conidia.

Type: China, Hubei, Wufeng, Houhe National Nature Reserve, on dead leaves of *Sycopsis sinensis*, 20 May 2009, Yixun Wang (**Holotype:** BPI 892531).

Etymology: referring to China for its origin.

Conidiomata sporodochial, circular to irregular, bright yellow when young, orange at maturity, scattered, hypophyllous, occasionally amphigenous, 200–300 µm diam. and 90–110 µm high. Conidiophores differentiated, erect, branched, flexuous or straight, colorless to pale yellow, smooth, septate, packed together. Conidiogenous cells integrated, terminal, holoblastic, straight or flexuous, bacilliform or ampulliform, sympodially elongated, smooth, thin-walled, colorless, (11–)12–16(–19) × (1–)1.2–1.4(–1.7) µm (mean = 14.4 ± 1.8 × 1.3 ± 0.1, n = 30), bearing mostly (1–)2(–3) conidia; apices of some conidiogenous cells ending with two flat-topped denticles of different lengths

Figures 1–8. *Linodochium sinense* (Holotype: BPI 892531). 1. Sporodochia on lower epidermis of a leaf of *Sycopsis sinensis*, 2. Cross-sections of sporodochia. 3. Conidiogenous cells and conidiophores. 4. Conidia on conidiogenous cells and four pairs of conidia on the right anastomosed into x-shaped derivative conidia. 5. An x-shaped derivative conidium. 6–7. Conidia on a conidiogenous cell with a dichotomous denticulate apex. 8. Three conidia on a conidiogenous cell with a trichotomous denticulate apex. Scale bars: 1 = 1 mm; 2 = 10 µm; 3–8 = 5 µm.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forming a dichotomy, some with one denticle and one flat conidiogenous locus on the other side of the conidiogenous cell apex, rarely, conidiogenous cells ending in a trichotomous denticulate apex. Conidia 1-septate, filiform, colorless, smooth, guttulate, (32–)34–40(–45) × (1–)1.1–1.5(–1.6) μm (mean = 37.5 ± 3 × 1.3 ± 0.2, n = 30), Q = (22.5–)24.5–32.1(–39.3) (mean = 28.3 ± 3.8, n = 30); some conidial pairs anastomosing to form x-shaped derivative conidia.

Teleomorph: unknown.

Geographical distribution: Hubei, China.

Habitat: dead leaves of *Sycopsis sinensis*.

Notes: *Linodochium* was erected by Höhnel (1909) and typified by *Linodochium hyalinum* (Lib.) Höhn. It remained monotypic for seven decades. Dyko & Sutton (1979) redescribed and illustrated the genus and *L. hyalinum*, its only species. Two years later, Minter & Holubová-Jechová (1981) added a second species, *L. formosum* Minter & Hol.-Jech. During the 1990's two more species were described: *Linodochium album* R.F. Castañeda & W.B. Kendr. (Castañeda & Kendrick 1990) and *L. hyalinum*, *L. sideroxyli* Dulym. et al. (Dulymamode et al. 1999). *Linodochium sinense* is the fifth species proposed in the genus. Much longer conidia differentiate *L. formosum* (80–140 μm with 2–4 septa; Dyko & Sutton 1979) and *L. hyalinum* (36–89 μm with <12 septa; Minter & Holubová-Jechová 1981) from *L. sinense*. White sporodochia and falcate conidia of *L. album* (Castañeda & Kendrick 1990) differ from the yellow sporodochia and filiform conidia of *L. sinense*. *Linodochium sideroxyli* is morphologically similar to *L. sinense* but differs in having wider conidia (1.5–2 μm, to 2.5 μm at the apex, 0–1 septum; Dulymamode et al. 1999) without dichotomous denticulate apices.

The significance of conidial anastomosis to form x-shaped derivative conidia in *L. sinense* is not clear. It might function as parasexual behavior or as part of sexual reproduction. However, further study is necessary to determine its function.

The teleomorph of *L. hyalinum* was found to be *Pseudohelotium pineti* (Batsch) Fuckel (Minter & Holubová-Jechová 1981). However, we found no teleomorph for *L. sinense*.

There are no DNA sequence data for any *Linodochium* species deposited in GenBank, and we were unable to isolate DNA from the *L. sinense* type specimen.

Key to species of *Linodochium*

1. Sporodochia yellow, amber, or orange 2
1. Sporodochia white to grayish white 4
2. Conidia 2–4-septate, 36–89 × 1–1.5 μm ..... *L. hyalinum*
2. Conidia 0–1-septate 3

3. Conidiogenous cells bearing 1–4 conidia, no denticles at apical end; conidia 0–1-septate, 32–48 × 1.5–2 μm, wider toward apex ..... *L. sideroxyli*
3. Conidiogenous cells bearing mostly 2 conidia, with dichotomous denticles at apex; conidia 1-septate, 34–40 × 1.1–1.5 μm, conidial anastomosis forming x-shaped derivative conidia ..... *L. sinense*
4. Conidia straight, <12-septate, 80–140 × 2–3 μm ..... *L. formosum*
4. Conidia falcate, 1–2-septate, 30–45 × 1–2 μm ..... *L. album*

New records for China

Candelabrum microsporum R.F. Castañeda & W.B. Kendr., Univ. Waterloo Biol. Ser. 35: 16 (1991)

Teleomorph: unknown.

Conidiophores reduced to conidiogenous cells. Conidiogenous cells monoblastic. Conidia subhyaline, solitary; conidial body multi-branched dicho- or sometimes trichotomously, with minute apical tubercles, forming globose, subglobose or elongated conidia, 35–55 μm diam.

Specimen examined: **CHINA, Hubei**, Wufeng, Houhe National Nature Reserve, dead leaf of *Sycopsis sinensis*, 28 August 2008, De-Wei Li (BPI 892532.

Ecology & distribution: On dead leaves of *Sycopsis sinensis; Palmae*. Previously known from Cuba; new record from China.

Note: Some conidia from the Chinese specimen are elongated and deviate slightly from the conidial shape of the holotype. Zhao et al. (2007) reported two other *Candelabrum* species in China, *C. brocchiatum* Tubaki and *C. spinulosum* Beverw. Both species were collected on decaying branches of an undetermined tree submerged in water in Dashuwang, Mount Tianmu, Zhejiang.

Chalara affinis Sacc. & Berl., Atti Ins. Veneto Sci. Lett.. Arti, Ser. 6 3: 741 (1885)

Teleomorph: unknown.

Conidiophores simple, erect, straight or slightly flexuous, cylindrical with an inflated base, <4 septate, sometimes constricted at the septa, pale brown, smooth, 40–70 μm long, 4–6 μm wide at the base. Phialides lageniform, pale brown, smooth, 35–50 × 4–6.5 μm. Conidia 1-celled, colorless, smooth, cylindrical, ends flat or slightly rounded, 8–11 × 1.5–2 μm, catenate.

Specimen examined: **CHINA, Hubei**, Wufeng, Houhe National Nature Reserve, dead leaf of *Sycopsis sinensis*, 28 August 2008, De-Wei Li (BPI 892533).

Ecology & distribution: On dead leaves of *Sycopsis sinensis*; *Pinus sylvestris* (Minter & Holubová-Jechová 1981). Previously known from Czech Republic and the United Kingdom; new record from China.

Note: the conidia from the Chinese material are slightly smaller than those of the type.

Cylindrocladium madagascariense Crous, Tax. Path. *Cylindrocladium*: 112 (2002)

Teleomorph: *Calonectria madagascariensis* Crous.

Conidiophores colorless, smooth, penicillate, 60–85 × 5–6.5 μm, with a septate extension, 130–350 μm long, terminating in a clavate vesicle. Phialides, colorless, smooth, allantoid, cylindrical, or doliiform, 9–11 × 3–4 μm. Conidia cylindrical, rounded at both ends, straight, colorless, smooth, thin-walled, 3-spetate, 50–55 × 4–5 μm.

Specimen examined: **CHINA, Hubei**, Wufeng, Houhe National Nature Reserve, dead leaf of *Sycopsis sinensis*, 20 May 2009, Yixun Wang (BPI 892534).

Ecology & distribution: On fallen leaves of *Sycopsis sinensis*; *Eucalyptus* sp., soil. Previously known from Congo and Madagascar (Crous 2002); new record from China.

Notes: The Chinese collection had shorter conidiophore extensions and slightly shorter conidia than those of the holotype. Crous (2002) reported that *Cylindrocladium madagascariense* is pathogenic to *Eucalyptus* sp., causing a leaf spot. It remains unknown whether this species does the same to *S. sinensis*. Further observation of *S. sinensis* foliage prior to leaf abscission is necessary to clarify this.

Subulispora britannica B. Sutton, Trans. Br. Mycol. Soc. 61(3): 422 (1973)

Teleomorph: unknown.

Conidiophores 20–40 × 3.5–4 μm, differentiate, solitary, straight or flexuous, 1–4 septate, smooth, thick-walled, pale brown to brown, sometimes with an enlarged base. Conidiogenous cells integrated, terminal polyblastic, sympodial, subhyaline to pale brown, thin-walled with 1–3 conspicuous flat unthickened scars. Conidia solitary, 3–10-septate, colorless, filiform, straight, thin-walled, smooth, 50–90 μm long and 2.5–3 μm wide at the base, attenuated toward the apex.

Specimen examined: **CHINA, Hubei**, Wufeng, Houhe National Nature Reserve, dead leaf of *Sycopsis sinensis*, 28 August 2008, De-Wei Li (BPI 892535).

Ecology & distribution: on dead leaves of *Sycopsis sinensis*; *Hedera helix*, *Ilex aquifolium*, *I. pernyi*, and *Quercus suber* (Kirk 1982). Previously known from Russia and UK; new record from China.

Notes: The Chinese conidiophores and conidia are slightly longer than those of the type.

New record for Mainland China

Menisporopsis novae-zelandiae S. Hughes & W.B. Kendr., N.Z. J. Bot. 6: 369 (1968)

Teleomorph: unknown.

Setae solitary, dark brown, pale brown toward the apex, <17 septate, 250–400 μm long, 8–14 μm at the base. Conidiophores 40–75 × 1.5–2 μm.

Conidiogenous cells monophialidic, smooth, colorless or subhyaline, straight or slightly curved, 15–20 × 3–4 µm. Collarette conspicuous, infundibuliform or cupulate, 2–3 µm wide, 1.5–3.5 µm deep. Conidia 1-septate, allantoid, colorless, smooth, 16–20 × 2.5–3 µm with a simple setula at each end, 4–6 µm long.

Specimen examined: **CHINA, Hubei**, Wufeng, Houhe National Nature Reserve, dead leaf of *Sycopsis sinensis*, 20 August 2009, Yixun Wang (BPI 892536).

Ecology & distribution: on dead leaves of *Sycopsis sinensis*; *Beilschmiedia tarairi*, *Cinnamomum osmophloeum*, *C. pedunculatum*, *C. zeylanicum*, *Cryptocarya mackinnoniana*, *Knightia excelsa*, *Litsea japonica*, palm, *Pasania edulis*, *P. kawakamii* (Hughes & Kendrick 1968, Matsushima 1980, 1989, 1993). Previously known from Australia, Ecuador, Japan, New Zealand (Matsushima 1975, 1980, 1989, 1993). This is the first report from Mainland China. Matsushima (1980) reported this species from Taiwan.

Notes: The Chinese collection had shorter setae than those of the type and its conidiogenous cells are not polyphialidic.

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